Hydrology and Earth System Sciences

Discussions

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comment

Interactive comment on "Assessing historic water extents in rapidly changing lakes: a hybrid remote sensing classification approach" *by* Connor Mullen and Marc F. Muller

Anonymous Referee #1

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General Comments

Mullen and Muller present a new method for producing time series of water extent in large, rapidly-changing and ecologically/culturally/economically important lakes. They use a novel approach implemented in Google Earth Engine (GEE) and validate their results against existing historical data, finding their method to work well, except when scenes contain snow/ice. Overall, the method is robust and the writing and figures in the manuscript are generally clear. However, I have several major concerns with the paper, chiefly related to the discussion of the method's limitations and the situation of this paper within the broader literature, described below. There are also several typos,

missing commas/parentheses and some incomplete sentences in the manuscript. I am not certain I caught all the errors, so I suggest the authors carefully edit the paper again before submitting a revised version.

Major Comments:

1. I would have thought that the specific cloud masking method could have a significant effect on the results, yet the cloud masking is only described in the SI and not given much attention in the manuscript. More discussion of the cloud masking method is needed in the main text. Furthermore, I would also suggest additional analysis and discussion about how the choice of a certain cloud-masking algorithm may or may not affect the results. For example, questions that I feel need to be addressed include what percent of pixels are cloudy/poor quality? How does this vary by lake/by year? Do lakes with greater cloudiness exhibit higher error than lakes with lower cloudiness?

2. The authors test their method over a small number of lakes – only 6 in total. But given the global availability of Landsat data, and the plethora of studies examining regional-to-global scale variability in surface water extent using Landsat/GEE (see comment #3), analyzing over only 6 lakes seems to me like a very small sample size. I encourage the authors to consider adding additional lakes to the analysis, perhaps with differ-ent environmental conditions such as in areas with high topography/high latitude (see comment #4). Relatedly, the authors should also consider adding discussion about the implementation of the method and the ease of running it – i.e. is the method compu-tationally slow and therefore would be challenging to run over large areas or could this be reasonably run over, say, hundreds of large reservoirs?

3. This manuscript requires additional discussion of how this method fits in with the (very large) literature on monitoring lake extent using optical satellite imagery. The manuscript makes little mention of the work of Pekel et al. Nature, (2016), who map global variability in water extent using Landsat and GEE, or regional studies such as Zou et al. PNAS, (2018) or Wang et al., Nature Geoscience, (2018), or even the large

literature on reservoir monitoring using MODIS or other optical sensors (e.g. Gao et al., Water Resources Research, 2012). While I do appreciate that this method is designed to produce highly accurate time series for individual lakes which is different than the goals of many of these other studies, I feel more discussion is needed to distinguish specifically how this method is an advance compared to this previous work and particularly, what specific scientific questions this approach could answer that other approaches could not.

4. Relatedly, I also feel this manuscript is lacking some discussion about limitations and specific applications. The discussion about the different assumptions of the method is good; however, I was left wondering more specifically where this method might work and where it might fail. For example, would this method work in areas of high topography/high latitudes where topographic shadowing is an issue? What is the smallest lake this method would work on? Is there a relationship between cloudiness/size/error? I would also advise more discussion about what might have caused the outlier points removed in the time series analysis.

Specific Comments:

L1: "The empirical attribution of 'past' rapid hydrologic change"

L15: change "when applicable" to "where available"

L15: I would advise adding a sentence at the end of the abstract stating the importance/broader significance of your findings, instead of just stating that your method works

L18: In my opinion, the first few sentences of the paper are weak. I would suggest rewriting slightly (i.e. "Despite their importance, many lakes are undergoing rapid change. . ." makes little sense – the importance of lakes doesn't necessarily mean that lakes will not or should not undergo rapid change). Since "rapidly changing" is a key part of the manuscript, I would also suggest defining what you mean by rapid change

since the time scale implied by "rapid" can vary based on the reader's background.

L27: This sentence ("By providing") should start the next paragraph, not sit at the end of this one as it interrupts the flow

L31: The paragraph starts by talking about monitoring surface water extent, but then discusses radar altimeters before moving back to extent. I would suggest restructuring this paragraph, or at least the first sentence of it, as the current structure is confusing

L83: I suggest adding a sentence or two to the final paragraph of the introduction stating something like "we test this method over XX lakes, analyze its accuracy and demonstrate its utility" just to provide readers with a better road map for the manuscript

L86: I would call this first step something like "Masking" instead of pre-processing (see major comment #1 above).

Figure 1: I like this figure, but think it could be improved slightly by increasing the size of the image panels and decreasing the size of the arrows and white space. The image panels are hard to see in places and there's plenty of white space so it should be straightforward to make them a bit larger and easier to see.

L149: The sentence starting with "Indeed, visual inspection of satellite..." is unclear. I think what the authors are stating is that the area-elevation curves do not match the satellite-observed area, but this section could be clarified.

Figure 3: Please make the x and y labels and the symbols themselves much larger, it is nearly impossible to read the figure at this scale.

L181: "The analysis suggests..." this is not a complete sentence, please edit

Figure 5: Please make x and y labels larger

L229: change phrase starting with "if shadows..." to "shadows covering dry land in the vicinity of the lake may cause an overestimation of the surface area of the lake"

L225-234: Does the cloud masking method remove cloud shadows?

L225-234: Is the influence of topographic shadowing examined? Topographic shadowing, particularly in the NY lake (in winter) could influence classification accuracy (and would not be a randomly distributed error). Even if most of the lakes specifically examined here occur in the tropics or in areas with little-to-no surrounding topography, topographic shadowing issues would likely impact the applicability of this method in other areas and therefore should be discussed